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The Role of Networks in Achieving Academic Library Goals

INTRODUCTION

The term "networks" is prominent in the proceedings of this conference and maintains its prominence in the title of this paper. For those whose background involves a heavy dose of computer networks, the term immediately conjures up the vast and continually growing infrastructure of computer networks now spanning the globe and the technologies that contribute to the spread of the network tendrils throughout our personal and professional communities. Indeed, even our definition and understanding of the term "communities" have been forever changed through network technologies, now including the notion of a "virtual community" linking us to individuals of like mind or spirit wherever they may be. To an increasing extent, we find members of our community with whom we establish a lasting relationship to be individuals whose personae are known to us only through the messages we exchange over a computer network.

But library colleagues are quick to broaden this perspective through reminders of the long tradition networking enjoys among libraries—networks growing out of a history of cooperation and coordination intended to cost-share resources and operations throughout the library community, thereby reducing local costs of operation and providing patrons with enhanced access to materials not held locally. I'm referring here, clearly, to the formation of the bibliographic utilities OCLC and Research Libraries Group (RLG), to interlibrary loan, and related services. Just as libraries provide patron access to information in a variety of forms, library networks are also found in many forms, but all are designed to move information. Extant networks serving this function utilize physical delivery networks such as the mail system, UPS, and couriers, as well as electronic delivery systems such as telefacsimile, commercial networks, and the Internet.

Just as new media types augment before they supplant old media types (if they ever supplant), new network technologies tend also to augment. The University of Maryland's use of the Internet has not reduced its use of UPS. Quite the opposite—remote patrons now use the Internet to identify and request materials they wish to borrow; available materials are then shipped by UPS to the University of Maryland library of their choice.

In this paper, I will look more closely at computer networks and, in particular, at how networks are affecting academic libraries' ability to meet their goals. I will consider a typical set of academic library goals, and then explore the interactions between network technology and meeting goals such as these, and the implications that follow. The apparently inevitable conclusion is that the tradition of sharing that already exists among libraries will become much more fundamental to the success of libraries. Indeed, even the notion of a library as a stand-alone physical entity may be in question as libraries become inextricably linked with each other in the pursuit of their goals. The virtual library concept evolves from this line of thought.

A MODEL FOR CONSIDERING ACADEMIC LIBRARY PLANS

Review of several noteworthy plans for academic libraries (Mosher, 1990, pp. 2-6; Strategic Directions, 1990, pp. 7-14; Commitment to Renewal, 1992) and reflection on planning activities in Maryland (Wellford et al., 1992; Larsen, 1993; Seymour Plan, 1992) suggest a common theme underlying current academic library plans. One can consider the goals and objectives expressed in these plans as products of an exploration of a three-dimensional abstract space whose dimensions are collections, services, and management. More specifically, planning activities can be viewed as exploring the three planes formed by the axes of this space: collection services, collection management, and services management. Full exploration of the three-dimensional space is a rigorous venture requiring measures that are at best uncertain and the consideration of a fourth dimension, time. Time is certainly not ignored in these plans but is embodied in analysis of, reflections on, and extrapolations of trends.

Simple measures along the axes are difficult to find. Certainly any measure that sufficiently characterizes the dimension for a modern academic library will be quite complex. But let us not be discouraged. This is a very simple model of a very complex world, after all. A suitable collections metric reflects breadth and depth of materials accessible to the patron. The services metric reflects search and access time and relevance of materials secured for the patron. The management metric is a utility measure perhaps analogous to return on investment. It includes the difficult optimization of resources across and beyond the campus libraries, including investment in collections, facilities, and people, while maintaining a management agility and adaptability to change. Without attempting to be more precise, let us continue, for these plans rely on experience and intuition more than mathematical rigor. The proposed model merely normalizes them to recognize common directions.

Imprecise as such a model may be, its power is in its ability to foster consideration of library goals and objectives in an abstract setting free of the conceptual blocks that frequently accompany tradition.

TYPICAL ACADEMIC LIBRARY GOALS

Libraries everywhere are wrestling with the same four forces: first, the number of published titles continues to increase geometrically; second, the cost

per title rises year after year, typically at a rate substantially greater than inflation; third, the cost of delivering services with human labor continues to rise; and, fourth, library budgets rarely keep up with inflation and are more frequently falling behind. The ability of academic libraries to meet the comprehensive needs of their local scholarly community with locally held resources is no longer in question. It is simply impossible. Partnerships that have historically been instrumental in improving library services are now vital to meeting the scholar's basic needs. Networks that once augmented library services now enable them.

It is perhaps ironic, but fortuitous nonetheless, that computing and communications costs have followed trends quite the opposite of those outlined above. For more than 40 years, the price/performance ratios for computing and communications technologies have typically fallen an order of magnitude each five years—that is a factor of 100 million since 1950! And this trend is expected to continue for at least another 15 years. So a useful, if not absolutely valid, question to raise is how academic libraries would change if computing and communications were absolutely free. The answer to this question would provide a major clue as to the nature of the library in the 21st century.

The goals espoused by contemporary academic libraries attempt to come to terms with these issues. How can the problems besetting libraries from the publishing community and the economy at large be offset by innovative and creative approaches that attempt to recast the traditions of academic librarianship in a world where affordable computing and communications technology is widely available? Let us now consider these plans.

Collection Services

The overarching goal of collection services is to provide effective and timely access to the full depth and breadth of relevant scholarly publication, regardless of medium. Collection decisions are increasingly driven by content rather than form, and networked information services are increasingly cited as a delivery mechanism of choice. In this view, the notion of a library that is electronically accessible at any time from any place begins to take on a seriousness that transforms an otherwise desperate prognosis into an opportunity to revitalize through collaborative interdependence.

Typical Goals

Three goals recur in academic library plans for their collection services. The first is a call to complete retrospective conversion and to keep ongoing cataloging up to date. This is an absolute requirement in an environment in which the public access catalog is the primary access tool for the collection. The second is to build online access to certain primary materials that are locally held. Whereas many people fantasize about the capability to access any and all materials electronically, it is clear that this will not be seen in our lifetimes. Existing print collections are simply too vast to anticipate providing online access to their content within the foreseeable future. There are portions of those collections, however, for which online access is appropriate in the near term. These include the unique or special collections that set each of our libraries apart, deteriorating materials for which electronic scanning is an appropriate

preservation alternative, and newly published materials that already exist in electronic form. These materials, in particular, are of interest, since they include multimedia, hypertext documents, and other electronic representations—materials that represent the leading edge of publication technology. The third common goal is to establish the interdependencies among networked libraries that render the electronic online collections of each library accessible and usable throughout the network. These three goals form the enabling foundation for the development of a network-based electronic virtual library.

Network Role

Networks play a fundamental, enabling role for collection services, and have done so for a considerable time. The best example of this is probably cataloging, which depends on network services from the bibliographic utilities. Many of these services have been delivered over dedicated, specialized networks but now are evolving toward Internet- and NREN-compatible facilities. This evolution is essential. We must move toward a common, ubiquitous network infrastructure in which competition and discrimination of services occur at the application level rather than at the lower levels of connectivity.

The burgeoning ability to link bibliographic records directly to primary content in network-deliverable form is clearly a network-enabled capability. It presents the potential for providing a major extension to the services available through libraries and opens the door to 24-hour-a-day access. It also raises protocol and policy issues regarding how to identify uniquely and access primary materials in a standard and generalized way. A satisfactory solution to these problems is essential, as this capability is the basic building block of the local electronic library.

Given local linkage from the bibliographic record to primary content accessible across the network, and given the ability to link bibliographic catalogs through the National Information Standards Organization (NISO) Z39.50 protocol, we now have two of the essential building blocks for the electronic virtual library—a network-based information infrastructure among libraries and other information sources that provides online patron access to organized information without regard for the relative location of the patron and the information. The third building block, yet to be addressed effectively, eliminates the need for the patron explicitly to select information sources based on their geographic location. The Internet metaphor is still largely one of navigation among information resources. I believe this metaphor is inappropriate to the electronic virtual library and will succumb eventually to a more versatile metaphor, more akin to union search of distributed library catalogs.

Internet-based projects such as the Wide Area Information Servers (WAIS) and Gopher begin to tackle the problem of finding and using information resources in a distributed environment. These are extremely valuable efforts through which we can hope to understand more about organizing and using networked information. Efforts such as these deserve aggressive support and informed leadership from the library community.

Collection Management

Collection management strives to acquire and ensure the local availability of information resources of greatest potential value to the immediate community

of scholars and researchers, while maintaining an integrity to the collection that transcends temporary fluctuations in funding and disciplinary priorities.

Typical Goals

Library planning documents reflect a growing concern for life cycle collection management, in which collection decisions consider not only immediate needs and sources but also the long-term impact of these decisions on the library and its constituency. An investment model hardly seems out of place here. The collection management job is fundamentally one of maximizing the return on investment in library materials by making the right choices early. The life cycle includes selection, acquisition, cataloging, circulation, maintenance, security, and preservation. Ironically, constrained budgets force libraries to invest more heavily in labor-intensive management in an effort to ensure that collection decisions are congruous with academic priorities. The difficulty of this process should be apparent to anyone who has attempted to sort out the academic priorities of a large university, let alone balance the competing interests of research (where breadth and depth is valued), instruction (where alignment with curriculum is required), and service (where broad-based access and ease of use are necessary).

Network Role

Networks play supportive roles for collection management. Electronic linkages to brokers and vendors support routine activities such as ordering of materials, paying of invoices, and filing of claims for missing materials. Dedicated lines and special-purpose networks have been put to this use with reasonable success in terms of internal library productivity. These services, as well, are migrating to the more general purpose, widely accessible Internet, but not just to serve back room interests of libraries and vendors. Catalogs and databases of available materials maintained by vendors and brokers are also of value to the patron interested in either finding materials inaccessible locally or influencing acquisitions decisions of the library.

Collection management is enhanced by linkage to interdependent libraries and information servers. As libraries scale back their acquisitions in light of decreasing budgets and increasing costs, cooperative collection analysis and development take on increased importance. Networks facilitate cooperative collection analysis among interdependent libraries, enabling optimization of acquisition strategies across a larger base, fostering cooperative collection development, and supporting the basic infrastructure for resource sharing.

Services Management

The goal of services management in academic libraries can be viewed as maximizing the return on investment in the people and facilities mediating between the patron and the collection, including the tools by which a patron finds relevant materials, accesses them, and uses them.

Typical Goals

Library plans typically include goals such as improving library infrastructure, empowering the patron, leveraging library expertise, and responding to institutional directions in efforts to improve a library's services to its community.

The technological components of plans to improve the utility of the library typically incorporate a recognition of the need for an integrated electronic information infrastructure, including hardware, software, data, and services. The importance of a consistent and intuitive online user interface is perhaps better understood by the library than by those more traditionally involved in technology-based development activities on campus.

A literate, self-sufficient patron improves the library's productivity by reducing the need to provide basic assistance. Library plans recognize the value of investment in bibliographic instruction and information literacy programs as a means of both empowering patrons and reducing professional staff hours in individual patron assistance. In addition, careful system design includes design goals supporting patron self-sufficiency.

Academic libraries invest heavily in highly educated, highly capable professionals who are masters in organizing information for subsequent access and use. More often than not, these information professionals also have discipline expertise required for organizing subject materials and communicating effectively with those creating and using them. These skills are important for providing subject-specific reference services but can also be used in an outreach capacity to assist scholars, academic departments, and administrative units in organizing their collections. The magnitude of this problem (and opportunity) only gets larger as the creation and use of networked information spreads.

Libraries are service organizations on campus. As such, they must be sensitive and responsive to institutional directions and priorities. Libraries on the campuses of state institutions must also be sensitive and responsive to the expressed needs and directions of the state. Academic library goals typically reflect this reality explicitly in such aims as supporting distance education, invigorating teaching and learning, and supporting state extension services.

Network Role

Services management provides one of the richest opportunities for the application of networks. Modernization of traditional services given a network infrastructure provides the starting point, followed shortly thereafter by innovation in outreach services, and ultimately by the transformation of patron services through the adaptation of modern network-based architectural concepts. Traditional personal services of the library, typified by reference desk activities, need to be generalized to the network environment. Existing electronic mail, bulletin board systems, and "chat" facilities provide the primitive platform on which to initiate such services. In addition, libraries can extend their value as service organizations by assisting in the organization of institutional electronic materials and then providing online access, through the library's catalog, to nonlibrary databases.

Public institutions, in particular, are encountering increasing pressures to extend their outreach and service activities to the public sector. This is evidenced by the growth in distance education, in economic development initiatives based on information access, and in broad-based, publicly sponsored network initiatives such as the Seymour Plan (1992), which strive to provide unmetered online access to public information for every resident of the state. For these programs to succeed,

online systems must be self-instructing and self-documenting. Few users will abide complex user manuals; most will sit impatiently through even the best online tutorials. Few institutions can afford the help desk that would otherwise be required to assist such a massive constituency. Network-based information systems must be intuitively usable at the entry level, yet sufficiently rich to meet the needs of the demanding user.

Most of today's online library systems are based on a primitive master/slave architecture for online systems. In this model, the user is perceived to be entering the system from a dumb terminal, and all of the information processing is performed centrally on a mainframe processor. Even though most remote users now access information systems from personal computers that have more power than the mainframes that existed when this model was devised, they run emulation programs that convert these powerful networked processors back into primitive dumb terminals. This model must be discarded as obsolete.

Contemporary network architectures are based on a client/server notion in which client and server are viewed as peer systems, both with substantial computational sophistication. In this model, the patron enters from a client system, accessing the library information server. The client manages the local patron interface, customizes it to the user's desires, and negotiates with the server system for the delivery of information and services that will meet the needs of the customer. The NISO Z39.50 protocol, for example, is based on this architecture, as is WAIS. (WAIS is actually based on an early version of the Z39.50 protocol.) This architecture is important in that it distributes the computational workload to machines specialized to specific functions. Valuable centralized mainframes designed for large-scale information management are no longer echoing characters to dumb terminals, and sophisticated end-users can tailor their local access facilities to their individual needs, desires, and interests. Valuable network resources can also be optimized to make more efficient use of communications capacity.

The client/server architecture is based on a one-to-one (client-to-server) model. It is not hard conceptually to extend it to a one-to-many (client-to-multiserver) model, but the model does not seem extensible to a many-to-many (multiserver-to-multiserver) interpretation. Yet, if our institutional trends are a credible guide, the need for collaboration among systems in a fairly general sense is not far away. This need may force the extension of the client/server model to a team model, in which the discrimination between user and provider becomes muted, to be replaced by a model based on cooperating distributed processes.

CONCLUSION: VIRTUALIZATION IS INEVITABLE

Economic forces and technological opportunities appear to point towards an unavoidable conclusion: fundamental change in academic libraries is inevitable, assured by economic forces and predestined by emerging technological alternatives. Academic libraries that aspire to meet the comprehensive needs of the 21st-century scholar will also recognize the impossibility of the task, if using only traditional approaches. Absolute comprehensiveness will be replaced by virtual comprehensiveness, which ultimately relies on a robust,

fast, demand-access acquisition strategy. A significant proportion of local collections will be built strictly on the basis of patron demand, supported by comprehensive access to bibliographic citations to the available literature. Not unlike the basic strategies governing the management of virtual memory in computer systems, libraries will implement a local collection management strategy that attempts to meet a substantial proportion of immediate, local needs with local collections, while providing virtual access to the entire corpus of published literature on a demand basis. This will be accomplished with a distribution system that delivers any scholarly publication anywhere within a reasonable period of time (24 hours seems reasonable in 1993, but this, also, may be subject to downward pressures).

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